THE UNIVERSITY OF BRITISH COLUMBIA

REPORT TO THE BOARD OF GOVERNORS

SUBJECT	**DOCTOR OF PHILOSOPHY IN COMPUTER SCIENCE**
MEETING DATE	**JUNE 5, 2019**

Forwarded on the Recommendation of the President

APPROVED FOR SUBMISSION

Santa J. Ono, President and Vice-Chancellor

DECISION REQUESTED	**IT IS HEREBY REQUESTED that *the Committees jointly approve program tuition and fees payable in the amounts and upon the conditions as set out in Appendix 1 to the report, effective 2019-2020 academic year.***
Report Date	April 26, 2019
Presented By	Deborah Buszard, Deputy Vice-Chancellor and Principal Ananya Mukherjee-Reed, Provost and Vice-President Academic Patricia Lasserre, Associate Provost, Enrolment & Academic Programs

EXECUTIVE SUMMARY

The Department of Computer Science, Mathematics, Physics and Statistics (CMPS) at UBC Okanagan proposes to offer a degree program for Doctor of Philosophy in Computer Science (PhD). It is an evolution of the training in computer science that has been offered within the interdisciplinary graduate studies (IGS) PhD program. It allows students in the current MSc in Computer Science to further their studies toward a career in academia or industry.

UBC already offers a degree program in Computer Science (PhD) at UBC Vancouver; tuition fees at UBC Okanagan will be in alignment with fees at UBC Vancouver.

Attachments

1. Appendix 1 – Program tuition and fee assessment details
2. Appendix 2 – Student consultation report
3. Appendix 3 – Letter of support from UBCSUO

STRATEGIC CORE AREAS SUPPORTED

☐ **People and Places** a **Research Excellence** ☐ **Transformative Learning** ☐ **Local / Global Engagement**

DESCRIPTION & RATIONALE

UBC Okanagan's CMPS department has offered graduate degrees in the Interdisciplinary Graduate Studies (IGS) program (MSc and PhD), and most recently, the MSc in Computer Science. Until now, students interested in a PhD program have been limited to the individualized IGS program for interdisciplinary research, or the mathematics PhD program for more theoretical research.

The proposed PhD in Computer Science will provide a disciplinary degree in a fast growing field. Students may focus their research in the following areas: artificial intelligence, network science, data analytics, data science, big data, human-centred technologies, optimization, scientific computing, and software engineering.

	With 12 research-stream faculty members (and four more new hires expected), the department has reached the critical mass necessary to offer a PhD program. Such a program will fill a gap in our degree offerings and is a critical milestone in meeting UBC research-intensive mandate.
BENEFITS Learning, Research, Financial, Sustainability & Reputational	The proposed PhD in Computer Science program will attract graduate students in high-demand fields and offer them high-quality education that will prepare them well for a career in academia or industry. The program will intensify research activities in computer science and better support faculty members' research, be it through grant applications or industry connections. A PhD program is one of the most impactful programs a university can have to support research. It will support the entrepreneurship culture of the Okanagan (while the Okanagan constitutes around 30% of the campus population, around 50% of our graduates stay in the Okanagan), and further ease the delivery of industry-sponsored grants. The program will also have an indirect impact on existing computer science programs at the undergraduate and MSc level. By offering a complete set of computer science programs (BSc, MSc, PhD), the campus will increase the interest of students who select universities with a wide-range of degrees to maximize their opportunities.
RISKS Financial, Operational & Reputational	Given the current and historical enrolment of graduate students in the IGS (interdisciplinary Studies) program, and the MSc, there is great confidence in the high demand for this program. Current students will be offered the option to transfer into the new PhD in Computer Science and a PhD track program will also be made available for MSc students after 12 months. As such, there is no financial risk in offering this program.
COSTS Capital & Lifecycle Operating	The program will not incur new costs, nor will it need extra capital to be offered.
FINANCIAL Funding Sources, Impact on Liquidity	Tuition fees for the program are set in alignment with the PhD in Computer Science in Vancouver and most other PhD programs across campuses as stated in both Academic Calendars.
SCHEDULE Implementation Timeline	The program is scheduled to launch in September 2019.
CONSULTATION Relevant Units, Internal & External Constituencies	Graduate Student Council (UBCO) and the UBC Students' Union Okanagan were consulted. The Graduate Student Council met in person with the program proponents on February 27, 2019. Students' questions on course offerings and tuition were answered and there was unanimous support for the proposal from their part. Additionally, the students' union was consulted via email and they distributed the invitation to their constituents, as they felt appropriate. The Executive of the students' union provided the attached letter of support.

Appendix 1 – Program Tuition and Fee Assessment Details

Program: Doctor of Philosophy in Computer Science

Start Date of the Program: 2019 Winter Session

	Domestic	International
Tuition fees per instalment – Note 1	$1,665.26	$2,925.58
Minimum No. of Instalments	6	6
Continuing Fees per Instalment (assessed after 9 instalments)	$760.80	$2,925.58
Application Fees (Graduate) – Note 2	$104.00	$168.25
Supplemental Application Fees	N/A	N/A
Other Faculty and Course Fees	N/A	N/A

Note 1 – Listed tuition fees are the standard rates approved for 2019/20. Proposed tuition will be subject to annual increases as established by the university. Tuition and student fees are charged in three equal instalments payable in January, May and September.

Note 2 – This is the current fee for the 2019W application cycle and is subject to annual increases.

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Doctor of Philosophy in Computer Science (Ph.D.)

I. K. Barber School of Arts and Sciences

University of British Columbia – Okanagan (UBCO)

Table of Contents

1 Executive Summary

The Department of Computer Science, Mathematics, Physics and Statistics (CMPS) at the University of British Columbia on the Okanagan campus proposes to offer a degree program for Doctor of Philosophy in Computer Science (Ph.D.). It is an evolution of the training in computer science that has been offered within the interdisciplinary graduate studies (IGS) Ph.D. program. It allows students in our M.Sc. in Computer Science to further continue their studies toward a career in academia or industry. It should be noted that UBC already offers a degree program in Computer Science (Ph.D.) on its Vancouver campus.

Computer Science at UBCO has been growing steadily with increased enrolments in our undergraduate programs and increased interest in our M.Sc. program. The department has just hired three assistant professors with Ph.Ds. in computer science to support new programs in data science and media studies. It is actively involved in delivering data science programs (B.Sc. major and minor, master of data science) in partnership with statistics, and the bachelor of media studies in partnership with the department of creative studies. Additional hiring in computer science is planned to meet the ministry approved new FTEs target. With 12 research-stream faculty members (and four more new hires expected), the department has reached the critical mass necessary to offer a Ph.D. program. Such a program will fill a gap in our degree offerings and is a critical milestone in meeting UBC research-intensive mandate.

Computer Science graduate programs are in very high demand, as they train students for employment in the fast growing fields of software development, information technology, and data science. The proposed Ph.D. in Computer Science program will attract graduate students in these high-demand fields and offer them high-quality education that will prepare them well for a career in academia or industry.

2 Overview

2.1 Introduction

UBCO's CMPS department has offered graduate degrees first in the Interdisciplinary Graduate Studies (IGS) program (M.Sc. and Ph.D.), and most recently, the M.Sc. in Computer Science. Until now, students interested in a Ph.D. program have been limited to the individualized IGS program for interdisciplinary research, or the mathematics Ph.D. program for more theoretical research.

The proposed program, **Ph.D. in Computer Science**, will provide a disciplinary degree in a fast growing field. Ph.D. students may focus their research in the following areas:

- Artificial Intelligence: machine learning, reasoning and algorithmic decision making, intelligent user interfaces, computer vision.
- Network Science: graph theory, network analytics, social network analysis, and applications in social media, computational biology, and brain science.
- Data analytics, data science, big data: business intelligence, data integration, data management, data mining, databases, health analytics, health informatics, learning analytics.

- Human-centered technologies: human computer interaction (HCI), visual, haptic and multimodal interfaces, visual analytics, immersive analytics.
- Optimization, scientific Computing: numerical methods and software, modeling, visualization.
- Software Engineering: development tools, software engineering analytics.

2.2 Credential

Doctor of Philosophy in Computer Science

2.3 Location

UBC Okanagan

2.4 Need for the Program

The program will train a small number of highly-qualified students in computer science. Besides research or teaching positions at universities or colleges, graduates will find many opportunities in industry. They would be qualified for the positions listed in Appendix A, with solid potential to advance to more senior-level positions. The program will provide UBCO students the opportunity to continue their graduate studies in the Okanagan[1].

The program will also intensify research activities in computer science and better support faculty members' research, be it through grant applications or industry connections. A Ph.D. program is one of the most impactful programs a university can have to support research. It will support the entrepreneurship culture of the Okanagan (while the Okanagan constitutes around 30% of the campus population, around 50% of our graduates stay in the Okanagan[2]), and further ease the delivery of industry-sponsored grants.

The program will also have an indirect impact on existing computer science programs at the undergraduate and M.Sc. level. By offering a complete set of computer science programs (B.Sc., M.Sc., Ph.D.), the campus will increase the interest of students who select universities with a wide-range of degrees to maximize their opportunities.

2.5 Faculty Offering Program

The Department of Computer Science, Mathematics, Physics, and Statistics (CMPS) within the I. K. Barber School of Arts & Sciences (Faculty of Arts and Sciences) on the Okanagan campus will offer the program.

[1]The student profiled on https://www.grad.ubc.ca/prospective-students/graduate-degree-programs/phd-computer-science as of 2018-05-17 is Yasha Pushak a graduate from UBCO computer science; the proposed program would provide research opportunities for such students at UBCO.

[2] OPAIR data partly based on the Baccalaureate Graduates Survey (BGS) http://outcomes.bcstats.gov.bc.ca/Publications/BGS_Publications/BGSReportsByDiscipline.aspx

2.6 Program Start Date

The program will be first offered starting September 2019 (soft launch). Students already enrolled in the existing IGS Ph.D. program will be given the option to transfer. The first normal recruitment cycle will focus on a September 2020 start date.

2.7 Program Completion Time

The anticipated completion time for the program is four years of full-time academic study.

2.8 Objectives and Program Learning Outcomes

The primary objectives of the proposed program are:

- To fill a gap in our program offerings for students who wish to pursue a career in academia or industry.
- To support research-stream faculty members in their research.
- To provide students with the most advanced research opportunities and train them in cutting-edge techniques to support the next generation of professionals for subsequent employment within education, government, and industrial sectors.

Graduates of the Ph.D. in Computer Science program will be able to

1. [critical thinking/ knowledge creation] apply problem solving, reasoning, and technical skills to solve problems with minimal guidance;
2. [communication] communicate concepts and results to a technical audience in the form of conference papers, journal papers, and oral presentations;
3. [knowledge dissemination] teach university-level computer science concepts and techniques;
4. [computing as a tool] implement programs using modern programming languages including selecting the most appropriate platform, evaluating the implementation efficiency, and listing performance bottlenecks;
5. [breadth] demonstrate a solid foundation of core Computer Science: algorithms, data structures, databases, scientific computing, software engineering;
6. [scientific method] conduct independent and innovative research that advances scientific knowledge within their field of expertise; and
7. [continuous learning] analyze current trends in computer science, and anticipate upcoming technological challenges.

2.9 Contributions to UBC's Mandate and Strategic Plan

By its very nature, the program supports UBC's Next Century strategic plan[3], in particular

- *People and places*: Strategy 3: Thriving Communities (Support the ongoing development of sustainable, healthy and, connected campuses and communities), especially through the department track record in industry-sponsored grants.
- *Research excellence*: Strategy 8: Student Research (broaden access to, and enhance student research experiences), Strategy 10: Research Culture (Foster a strong and diverse research culture that embraces the highest standards of integrity, collegiality and service).
- *Transformative learning*: Strategy 13: Practical Learning (Expand experiential, work-integrated and extended learning opportunities for students, faculty, staff and alumni), Strategy 15: Student Experience (Strengthen undergraduate and graduate student communities and experience); the intrinsic mentoring nature of a Ph.D. program that focuses on a one-to-one learning environment is the most effective learning method. The research labs fosters effective students-to-students interactions while the mandatory minimum funding allows students to focus exclusively on their research.
- *Local and global engagement*: Strategy 16: Public Relevance. (Deepen the relevance and public impact of UBC research and education).

The program also supports UBCO's Aspire strategic plan[4], namely:

- *Transformative student learning*: expanding experiential learning opportunities… through community partnerships e.g., MITACS accelerate funding for graduate students.
- *Research excellence*: …make research more accessible, identify research with local and global impact (creating innovation hubs, facilitate more robust graduate programming and research opportunities).
- *Community engagement*: creating innovation hubs.
- *Place*: identify strategies to maintain a distinctive learning environment, strengthen cultural diversity (most of our graduate students are international[5]), strategies to support the development of this campus.

[3] https://strategicplan.ubc.ca/wp-content/uploads/2018/04/2018_UBC_Strategic_Plan_Full-20180425.pdf
[4] https://aspire.ok.ubc.ca/
[5] In the M.Sc. in computer science, 14/20 students have been international while they were 15/16 in the M.Sc. in Interdisciplinary Studies, Optimization theme.

2.10 Student Interest and Enrolment Expectations

The number of applicants supervised in the IGS M.Sc. oscillated between 10 and 30 until the M.Sc. in Computer Science was launched last year. The M.Sc. in computer science attracted 35 applications last year and 140 this year. Like at the M.Sc. level, it is expected the demand for a Ph.D. in computer science will be much stronger than for a Ph.D. in IGS. Demand will be further boosted by the arrival of new faculty members who provide both more diverse areas of research and increased capacity to supervise graduate students.

With 12 research faculty members, we expect the program to ramp up to 5 students quickly, with the potential to graduate 6-12 students per year after 5-7 years.

Student interest is influenced by the growing interest in computer science in general. The undergraduate course enrolment in Computer Science has grown quadratically and reflects growing overall demand. The 10-year (resp. 5-years, 3-years, 1-year) overall growth is 20% (resp. 22%, 23%, 24%). The growth of the undergraduate program has caused a major issue with finding qualified TAs. The Ph.D. program will allow us to recruit more and better qualified graduate students and fund them as GTAs. This will improve the educational experience for undergraduate students while providing teaching opportunities for graduate students.

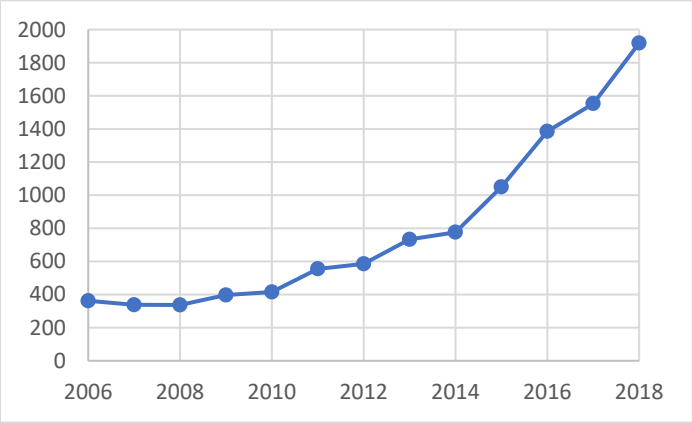


Figure 1: Number of students registered in COSC courses from 2006 to 2018

Table 1: Number of students registered in COSC courses from 2006 to 2018

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Regist.	362	338	337	397	415	555	585	733	776	1050	1385	1553	1918
Growth		-7%	0%	18%	5%	34%	5%	25%	6%	35%	32%	12%	24%

Enrolment data for the program at UBCV is summarized in the table below[6]. Although the demand for Ph.D. programs is mostly driven by the reputation of research faculty members, the table shows there is unmet demand, e.g., in 2017 there is a significant difference between the number of applications received and total enrolment.

	2017	2016	2015	2014	2013
Applications	151	142	129	111	131
Offers	15	15	11	14	11
New registrations	13	12	6	9	6
Total enrolment	76	78	76	83	81

Alumni have found positions in higher education (research-intensive universities) and industry (research scientist/engineer, software engineer, chief technology officer, product manager, software development engineer, data scientist at Google, Microsoft, Amazon, Intel) [7] .

2.11 Delivery Methods

The program is delivered in accordance with the Graduate Studies standard practice.

2.12 Linked Learning Outcomes and Curriculum Design: assessment plan

Learning Objective	Assessment
Knowledge creation (critical thinking, problem solving)	Originality of research contributions (articles, conferences)
Communication (oral)	Research proficiency oral evaluation, thesis proposal oral examination, dissertation defense; conference presentations
Communication (written)	Research proficiency written report, thesis proposal, dissertation; article proceedings, journal articles
Knowledge dissemination	Teaching experience as TA, sessional; seminars, publications
Tool mastery: computing	Coursework/projects, prototype research code to validate article contributions
Breadth	Comprehensive course requirements on core foundation
Research	Research plan (innovative ideas, impact, student contribution)
Continuous learning	Bibliography for dissertation, conference attendance

[6] https://www.grad.ubc.ca/prospective-students/graduate-degree-programs/phd-computer-science
[7] https://www.grad.ubc.ca/prospective-students/graduate-degree-programs/phd-computer-science

The curriculum is designed to prepare students for potential sectors of employment in academia or industry including as programmers, software developers, software engineers, business analysts, data scientists, big data developers, or data engineers.

While work experience/work place term is not mandatory in the program, industry-sponsored grants (MITACS Accelerate, NSERC Engage, NSERC Collaborative Research and Development) will be available to better prepare students to tackle real-world problems found in industry.

2.13 Program Strengths

The program builds on the increasingly stronger research by department faculty members in a society that depends on software, data, computers, and critical thinking. It leverages the start-up culture of the Okanagan and trains leaders with much needed solid technical expertise. The program will have a direct impact on companies in the Okanagan.

2.14 Related Programs at UBC and other BC Post-Secondary Institutions

UBC Vancouver, the University of Victoria, and Simon Fraser University have offered a Ph.D. in Computer Science for many years. The geographical location justifies creating the program at UBC Okanagan.

2.15 Institutional Contacts / Proponents

Yves Lucet, Department of Computer Science, Mathematics, Physics and Statistics
yves.lucet@ubc.ca; 250-807-9505

3 Program Description and Specification

Similarities and Minor Differences to UBC-Vancouver Program

Both programs share the same objectives and are aligned in the same way with the UBC Mandate and Strategic Plan. Similarly, the context, demand, and expected interest for the program is the same. The difference is in the expertise of faculty members on each campus and on minor operational differences. See Appendix C for a curriculum mapping document showing the alignment.

Minimal funding policy[8]

In May 2017, the UBCV Senate approved the establishment of a university-wide minimum funding level for all Ph.D. students. Specifically, all full-time students who begin a UBC Vancouver Ph.D. program in September 2018 or later will be provided with a minimum funding package equal to $18,000 for each of the first four years of their Ph.D. The funding package may consist of any combination of internal or external awards, teaching-related work, research assistantships, and graduate academic assistantships.

[8] https://www.grad.ubc.ca/awards/minimum-funding-policy-phd-students

Although such a policy is not in place at UBCO, the M.Sc. in computer science program has a mandatory minimal funding of $17,500[9] per year for 2 years. Similarly, the proposed Ph.D. program will have a mandatory minimal funding of $21,000[10] per year for 4 years.

3.1 Admission Requirements

Applicants to the program are admitted as part of the general admission for graduate students[11]. Admission requirements include an M.Sc. in computer science or related field. Applicants with a degree not specifically in computer science are expected to have undertaken coursework in computer science, such as the equivalent of a minor in computer science. An overall average of B+ (76% or higher) in the student's M.Sc. course work is normally required.

In exceptional cases, applicants who hold an honours bachelor's degree may be granted direct admission on recommendation of the admitting graduate program and approval of the Dean of the College of Graduate Studies[12]. In addition to these requirements, students need to satisfy the following to stay in the program: pass 12 credits in 500-level coursework with an overall average of at least 85%, pass the research proficiency evaluation, and receive continuous approval and support (including financial) from the dissertation supervisor. All conditions will be lifted no sooner than 12 months, but no later than 18 months, in the program. Should a student fail to satisfy the conditions, they will be asked to either transfer into the M.Sc. program (assuming they meet eligibility requirements) or withdraw from the program[13].

Other requirements[14] from the College of Graduate Studies apply, e.g., English language proficiency requirements.

Ph.D. Track Program[15]

Well-qualified students admitted to the M.Sc. program may transfer to the Ph.D. program after 12 months, but no more than 18 months, in the M.Sc. program, if they have at least 12 credits in 500-level coursework with an overall average of at least 85%, clear evidence of research ability supported by passing the research proficiency evaluation, and approval of the dissertation supervisor.

[9] The amount matches NSERC Canada Graduate Scholarships
[10] The amount matches NSERC Postgraduate Scholarships-Doctoral Program
[11] http://www.calendar.ubc.ca/okanagan/proof/edit/index.cfm?tree=18,285,998,1196
[12] http://www.calendar.ubc.ca/okanagan/proof/edit/index.cfm?tree=18,285,998,1196
[13] Admitting directly into the Ph.D. with an honours is already possible for most Ph.D. degrees, e.g., Ph.D. in Mathematics; the present paragraph only clarifies the conditions to satisfy. Allowing such admission at the Ph.D. level is very important to compete with US institutions.
[14] http://www.calendar.ubc.ca/okanagan/proof/edit/index.cfm?tree=18,285,998,1196.
[15] https://www.cs.ubc.ca/students/grad/policies/grad-handbook/phd-track-within-msc-program/coursework-phd-track-program, https://www.grad.ubc.ca/faculty-staff/policies-procedures/transfer-masters-doctoral-programs-without-completing-masters

3.2 Program Requirements

The program has four components normally taken in the following order:

1. **Research proficiency evaluation:** requires carrying out a small research project, writing a technical report, and defending the results orally in front of the student supervisory committee. At UBCO, this requirement is formalized as passing the course COSC 690 (3) Research Skills (most students are expected to complete COSC 690 in the first 8 months; all students should complete it in the first 12 months). The intent is to quickly detect students who do not meet Ph.D.-level research expectations.
2. **Comprehensive requirement:** assess breadth and ensure students have the background to carry out the research. Following the same format as UBCV CPSC, this requirement will be satisfied by passing 15 credits of breadth requirements and 9 credits of depth requirements. Upper-level courses and above taken during the bachelor, master or Ph.D. can count toward that requirement. The rationale to require students to take courses instead of self-studying and passing an exam is that, in most cases, the comprehensive exam is the final exam of a graduate level course. Taking courses simplifies the process, increases the quality assurance, makes the program easier to deliver, and provides more opportunity, e.g., by allowing UBCV CPSC courses. A generic list of allowed courses will be available on the COSC website, and the program coordinator will approve each change to ensure the program integrity.
3. **Thesis proposal oral examination:** write a thesis proposal and defend it in front of the supervisory committee. This is the standard dissertation prospectus presentation. While a course could also be created for that purpose, it would create unnecessary scheduling constraints since the timeline for such oral examination is very specific to each student, contrary to the research proficiency examination that has to be taken early.

   At this point the candidate has advanced to **candidacy.**

4. **Research program completion:** carry out research under the supervisor's guidance, write the dissertation, and pass the defense; this is COSC 649.

Advancement to candidacy requires passing the comprehensive requirement, the research proficiency evaluation, and the thesis proposal oral examination. Students are expected to advance to candidacy within the first 24 months in the program; they will be required to withdraw from the program if they have not advanced within 36 months as per CoGS policies.

Resources

Human Resources

The following faculty members with experience in research or graduate supervision will support the program.

Name	Rank	Recent Funding	Research Expertise
Jeffrey Andrews	Assistant Professor	DG, Engage, Accelerate	Unsupervised machine learning, mixture models, scientific computing
John Braun	Professor	DG, CANSSI	Scientific computing, computational statistics, statistical education
Yong Gao	Professor	DG	Artificial intelligence, network science, algorithms
Donovan Hare	Associate Professor	Applying to DG	Discrete optimization
Warren Hare	Associate Professor	DG, CRD, Engage, Accelerate	Scientific computing, optimization, nonconvex analysis
Mohammad Khalad Hasan	Assistant Professor	Applying to DG	Human-centered technologies, user experience, media studies
Fatemeh Hendijani Fard	Assistant Professor	Applying to DG	Software engineering, data science
Patricia Lasserre	Associate Professor	Accelerate	Human-centered technologies, human-computer interaction, computer vision, computer science education
Ramon Lawrence	Associate Professor	DG	Data management, databases, algorithms, innovative teaching systems
Jason Loeppky	Associate Professor	DG, CRD, Engage	Machine learning, Design and analysis of experiments for physical processes and computer-based simulations
Yves Lucet	Professor	DG, CRD, Engage, Accelerate	Scientific computing, optimization, convex analysis, algorithms, computer science education
Apurva Narayan	Assistant Professor	Applying to DG	Software engineering, data science

Abbreviations: DG (NSERC Discovery Grant), CRD (NSERC Collaborative Research and Development grant), Engage (NSERC Engage grant), Accelerate (MITACS Accelerate grant), CANSSI (Canadian Statistical Sciences Institute).

The following table summarizes specialties (AI: artificial intelligence/machine learning, NS: network science, DS: data analytics/data science/big data, HCT: human-centered technologies, OPT: Optimization/scientific computing, SE: software engineering).

Name	AI	NS	DS	HCT	OPT	SE	Total
Jeffrey Andrews	0.3		0.3		0.3		1.0
John Braun	0.3		0.3		0.3		1.0
Yong Gao	0.5	0.5					1.0
Donovan Hare		0.5			0.5		1.0
Warren Hare					1.0		1.0
Mohammad Khalad Hasan				1.0			1.0
Fatemeh Hendijani Fard			0.5			0.5	1.0
Patricia Lasserre				1.0			1.0
Ramon Lawrence			1.0				1.0
Jason Loeppky	1.0						1.0
Yves Lucet					1.0		1.0
Apurva Narayan	0.3		0.3			0.3	1.0
Total	2.5	1.0	2.5	2.0	3.2	0.8	12.0

In addition to the 12 faculty members above, the department has been approved and is in the process of hiring 2 assistant professors, with a starting date in 2019, bringing the total to 14 active researchers supporting the program. Government funding to further expand the computer science program was granted and a further 2 additional positions are expected within 3 years. (The department is also hiring 1 assistant professor in computational physics, and another in computational algebra who are expected to have strong link with the program.)

Space

There is no change in space requirements arising from the creation of this program. The department will host graduate students in existing and future research labs, most of them CFI/BCKDF-funded.

Appendix A: Computer Science Job Market

The best jobs of 2017 (https://www.careercast.com/jobs-rated/2017-jobs-rated-report) include (median salary and projected growth are in parenthesis)

- #4 Information Security Analyst ($90K/yr; 18%)
- #5 Data Scientist ($111K; 16%)
- #8 Software Engineer ($101K/yr; 17%),
- #13 Computer Systems Analyst ($86K/yr; 22%)
- #19 Network and Computer Systems Administrator ($78K/yr; 10%)
- #25 Web developer ($66K/yr; 24%)
- #49 Computer programmer ($80K/yr; -8%)

The toughest jobs to fill in 2017 from Forbes (median salary; 8 year growth outlook)

- #4 Data scientist ($128K/yr; 16%)
- #6 Software engineer ($101K/yr; 17%)
- #8 Information security analyst ($90K/yr; 18%)

The 25 best-paying jobs for women right now (median salary)

- #4 Computer and information systems manager ($81K/yr)
- #7 Software developer, applications and systems software ($73K/yr)
- #10 Computer programmer ($68K/yr)
- #13 Computer system analyst ($65K/yr)

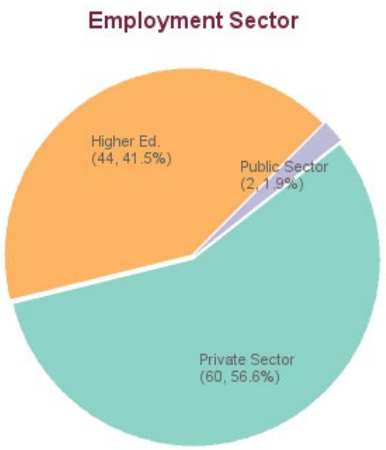
BC High demand management occupations (job openings by 2028; median wage rate 2017):

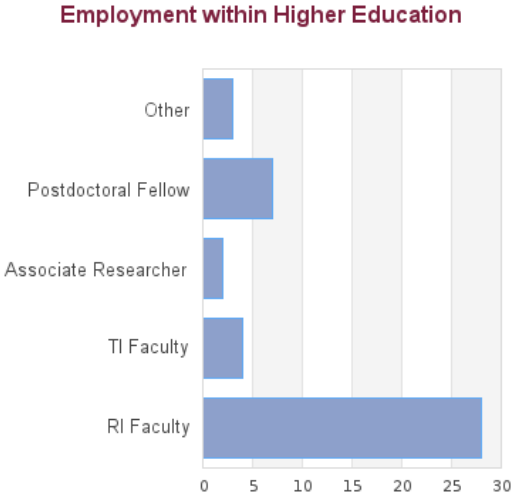
- Management: #5 Computer and information systems managers (4,800; $43.27)
- Occupation: #3 Information systems analysts and consultants (8,700; $38.46)
- Occupation: #4 Computer programmers and interactive media developers (8,000; $38.46)
- Occupation: #8 Software engineers and designers (4,800, $38.46)
- Occupation: #18 Web designers and developers (2,300; $25.00)
- Occupation: #25 Computer engineers (except software engineers and designers) (1,100; $40.50)

Appendix B: UBCV Ph.D. Career Outcomes

Information on UBCV Ph.D. in computer science outcomes[16] is summarized below; a thorough study of Ph.D. career outcomes was performed in 2017[17].

111 students graduated between 2005 and 2013. Of these, career information was obtained for 106 alumni (based on research conducted between Feb-May 2016):





RI (Research-Intensive) Faculty: typically tenure-track faculty positions (equivalent of the North American Assistant Professor, Associate Professor, and Professor positions) in Ph.D.-granting institutions
TI (Teaching-Intensive) Faculty: typically full-time faculty positions in colleges or in institutions not granting Ph.Ds., and teaching faculty at Ph.D.-granting institutions
Term Faculty: faculty in term appointments (e.g., sessional lecturers, visiting assistant professors, etc.)

SAMPLE EMPLOYERS IN HIGHER EDUCATION

University of British Columbia (5)
McGill University (3)
University of Waterloo (3)
University of Manitoba (2)
Swansea University
Stanford University
University of Utah
Ecole Polytechnique Federale de Lausanne (EPFL)
Swiss Federal Institute of Technology
University of Saskatchewan

SAMPLE EMPLOYERS OUTSIDE HIGHER EDUCATION

Google (12)
Microsoft (4)
Amazon (3)
Intel Corporation (3)
Disney (2)
Oracle Labs (2)
IBM (2)
Tasktop Technologies (2)
Tableau (2)
OriGene Technologies Inc.

SAMPLE JOB TITLES OUTSIDE HIGHER EDUCATION

Research Scientist (5)
Software Engineer (5)
Senior Software Engineer (4)
Chief Technology Officer (3)
Product Manager (3)
Software Development Engineer (2)
Senior Data Scientist (2)
Senior Research Engineer (2)
Advisory Engineer
Senior Research Scientist

[16] https://www.grad.ubc.ca/prospective-students/graduate-degree-programs/phd-computer-science
[17] http://outcomes.grad.ubc.ca/ full report available at http://outcomes.grad.ubc.ca/docs/UBC_PhD_Career_Outcomes_April2017.pdf

Appendix C: Curriculum Mapping

Learning objective	UBCV	UBCO
Research Proficiency Evaluation	Written report and oral exam	COSC 690, which also requires a written report and oral exam
Comprehensives	15 credits of breadth and 9 credits of depth	Same
Thesis proposal	Oral exam	Same
At this point the candidate has advanced to **candidacy.**		
Research completion	Thesis written and approved by external examiner and 2 UBC examiners (1 from the department, 1 from outside). Successful defence. Completion of CPSC 649 (0) Doctoral Dissertation	Same except completion of COSC 649 (0) Doctoral Dissertation

STUDENT TUITION CONSULTATION REPORT

The Associate Vice-President, Students Office, in partnership with the Irving K. Barber School of Arts and Sciences conducted a student consultation regarding the proposed program, **Ph.D. in Computer Science.**

The Department of Computer Science, Mathematics, Physics and Statistics (CMPS) at the University of British Columbia on the Okanagan campus proposes to offer a degree program for Doctor of Philosophy in Computer Science (Ph.D.). It is an evolution of the training in computer science that has been offered within the interdisciplinary graduate studies (IGS) Ph.D. program. It allows students in our M.Sc. in Computer Science to further continue their studies toward a career in academia or industry. It should be noted that UBC already offers a degree program in Computer Science (Ph.D.) on its Vancouver campus.

Student Representative Bodies Invited to the Consultation
Graduate Student Council (UBCO) and the University of British Columbia Students' Union Okanagan.

Mode of Consultation
The consultation consisted of a face-to-face meeting with the Graduate Student Council (UBCO). We met with current graduate students on February 27, 2019. At this meeting, all of the required Program information was shared.

The Students Union was invited to the consultation through email, and asked to distribute the invitation to their constituents, as they felt appropriate.

Basis of Consultation: The consultation was based on the proposed Program Summary document above.

Summary of Student Feedback: Submissions were requested from the University of British Columbia Students' Union Okanagan (UBCSUO) and the Graduate Student Council (UBCO). The Graduate Student Council (UBCO) was provided with this package for preview on February 11, 2019.

We met with Dr. Bernard Momer and the Graduate Student Council (UBCO) on February 27, 2019 to carry out the consultation. There Dr. Momer provided a rational for the program tuition. There were two questions put to Professor Momer.

Are you certain that there will be sufficient course offerings to support the program? Profession Momer was able to provide a satisfactory and reassuring response.

How does the tuition for this program correspond to tuition for similar programs? Profession Momer was able to provide a satisfactory response.

There was unanimous support for the proposal from the Graduate Student Council (UBCO) and there were no outstanding concerns expressed.

The Executive of the Students Union Okanagan were also invited to meet and to provide feedback. They have provided the attached letter.

Student's Union of the University of British Columbia Okanagan
3272 University Way, UNC 133
Kelowna, British Columbia
V1V 1V7
T: 250-807-8842
F: 250-807-8079
www.ubcsuo.ca

Dear Ian Cull,

Thank you for giving students the opportunity to provide feedback for the proposed Doctor of Philosophy in Computer Science (Ph.D.) Tuition fees.

After careful consideration, it is our recommendation that no further consultation for the Doctor of Philosophy in Computer Science Tuition fees is needed.

The overview of the new Doctor of Philosophy in Computer Science (Ph.D.) program was thorough, with attention brought to the tuition fee and the accordance with the current tuition for doctoral studies. We fully support the creation of the new program, and believe it will be an evolution of the training in computer science that is a unique addition to our campus.

Sincerely,

Amal Alhuwayshil